IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA,	)	
	)	
Plaintiff,	)	
	)	
v.	)	**Case No. 05-cv-329-GKF-PJC**
	)	
TYSON FOODS, INC., et al.,	)	
	)	
Defendants.	)	

STATE OF OKLAHOMA'S RESPONSE TO DEFENDANTS' MOTION TO EXCLUDE THE TESTIMONY OF ROGER OLSEN PURSUANT TO *DAUBERT v. MERRELL PHARMACEUTICALS, INC.* [DKT #2082]

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The State of Oklahoma ("the State") hereby submits this response in opposition to Defendants' Motion to Exclude the Testimony of Roger Olsen ("Dr. Olsen"). The Court should deny Defendants' motion for the following reasons.

I. Introduction

Defendants seek to exclude Dr. Olsen's testimony concerning his multivariate statistical analysis – principle component analysis ("the PCA"). Principle component analysis is a type of multivariate statistical analysis which is commonly applied in environmental science. It is conducted in order to identify correlation patterns among multiple samples and multiple variables (or "parameter" which represent chemical or bacterial concentrations measured in samples). These correlation patterns are shaped by the underlying environmental factors that are particular to the locations being studied. When the factors shaping the correlation patterns are due to sources of contamination, these patterns (produced by principle component analysis) reflect these sources of contamination. And, the water samples from which these patterns are derived are identified as being contaminated by a particular source.

The PCA conducted by Dr. Olsen is only one part of the State' causation - fate and transport - analysis concerning the phosphorous and bacterial contamination of the Illinois River Watershed ("IRW"). Defendants' motion seeks to exclude only one of the many studies performed and considered by Dr. Olsen in forming his opinions. Indeed, contrary to Defendants' claim that no traditional fate and transport analysis has been done in this case; the State's experts have explored virtually every established method of contamination source identification and fate that are applicable to the facts and circumstances of this case.

As shown below, the PCA was based on commonly used, well-accepted scientific theory and methodology that is part of the science of environmental contaminant source identification. Furthermore, the underlying scientific theory and methodology was reliably applied in the PCA development which included the investigation and study of numerous lines of evidence that explore the fate and transport of phosphorous and bacteria in the IRW. These other lines of evidence serve as corroboration of the reliability of the PCA. The PCA is and has been subjected to testing, including extensive sensitivity analysis, and has been reproduced by Professor Loftis and Defendants' retained experts Drs. Johnson and Murphy. Moreover, the theory and methods of the PCA in general as well as the specific application of the PCA methods to this case are supported by peer reviewed scientific literature. Therefore, the PCA is judged reliable by every means of applicable analysis suggested by *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 589 (1993).

II. Discussion

A. Legal Standard.

The basis for admitting expert opinions is Rule 702 of the Federal Rules of Evidence:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

As an initial matter, the court must determine if the expert is qualified by "knowledge, skill, experience, training, or education" to render an opinion. *Id.* In this case Defendants do not seriously contest Dr. Olsen's expertise in the subject area of principle component analysis. Indeed, a review of Dr. Olsen's experience and qualifications indicates the he is extraordinarily well qualified in this area of scientific investigation having performed numerous environmental investigations and studies that included evaluating the fate and transport of chemicals in the environment and determining the cause or source of contamination. Dr. Olsen is also the author or co-author of over 120 publications/presentations and over 400 technical reports relating to environmental contamination. His education include graduate level courses in statistics and he has routinely performed statistical analyses as part of his evaluation of environmental data. He has also taught statistical courses for State Regulatory Agencies and the staff at his employer, Camp, Dresser and McKee ("CDM"). Dr. Olsen has performed principal component analyses many times to assist in understanding the relation of multiple parameters and to identify sources of contamination, including work for United States Department of Justice to evaluate the sources of groundwater contamination. *See,* Exhibit A (Olsen Decl. ¶¶ 1-2).

Next, a court must ensure that the scientific testimony being offered is "not only relevant, but reliable." *See Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 589 (1993). "To be reliable under *Daubert*, an expert's scientific testimony must be based on scientific knowledge . . . ." *Dodge v. Cotter Corp.*, 328 F.3d 1212, 1222 (10th Cir. 2003). The Supreme

Court has explained that the term "scientific" "implies a grounding in the methods and procedures of science." *Daubert*, 509 U.S. at 590.

The Supreme Court has set forth four non-exclusive factors that a court may consider in making its reliability determination: (1) whether the theory or technique can be (and has been) tested, *id.* at 593; (2) whether the theory or technique has been subjected to peer review and publication, *id.*; (3) the known or potential rate of error and the existence and maintenance of standards controlling the technique's operation, *id.* at 594; and (4) whether the theory or technique has general acceptance in the scientific community, *id.* Importantly, the Supreme Court cautioned that the inquiry is "a flexible one." *Id.*; *see also id.* at 593 ("[m]any factors will bear on the inquiry, and we do not presume to set out a definitive checklist or test"); *Dodge*, 328 F.3d at 1222 ("the list is not exclusive").

Finally, the Supreme Court stated that it is not the conclusion reached by the expert, rather the methods used to arrive at the conclusion that are at issue: "The focus [of the inquiry]. . . must be solely on principles and methodologies, not on the conclusions that they generate." *Daubert*, 509 U.S. at 595. The Tenth Circuit has stated the same principle this way:

> The plaintiff need not prove that the expert is undisputably correct or that the expert's theory is "generally accepted" in the scientific community. Instead, the plaintiff must show that the method employed by the expert in reaching the conclusion is scientifically sound and that the opinion is based on facts which sufficiently satisfy Rule 702's reliability requirements.

Mitchell v. Gencorp Inc., 165 F.3d 778, 781 (10th Cir.1999), *see also, Truck Insurance Exchange v. Magnietek, INC*, 360 F.3d 1206, 1210 (10th Cir. 2004).

B. The PCA satisfies all of the applicable *Daubert* reliability indicia.

As demonstrated below, the PCA is reliable and based on all of the applicable *Daubert* criteria. [1] The PCA theory and methodology has general scientific acceptance. Moreover, this general theory and methodology have been reliably used by Dr. Olsen as those theories and methods have been specifically applied in the PCA development. The PCA is and has been subjected to testing. Finally, the theory and methods of the PCA in general as well as the application of the PCA methods specific to this case are supported by the peer reviewed scientific literature.

1. The PCA is based on well-accepted scientific theory and methodology.

One of the factors suggested by *Daubert* to evaluate the reliability of an expert opinion is consideration of whether the expert's theory has "general acceptance" in the scientific community. While *Daubert* does suggest that "general acceptance" is a factor to be considered by a court, it is careful to note that "general acceptance" is not required under the federal rules. *Daubert,* 509 U.S. at 588-89. The passage of Federal Rule of Evidence 702 liberalized admissions criteria of expert opinions beyond the rigid "general acceptance" test announced in *Frye v. U.S.*, 293 F. 1013 (D.C. Cir. 1923). *Id.* Under the Federal Rules of Evidence, for an expert's testimony to be admissible a litigant, "need not prove that the expert is undisputably [sic] correct or that the expert's theory is 'generally accepted' in the scientific community." *Mitchell v. Gencorp, Inc.*, 165 F.3d at 781 (citations omitted). Rather, a litigant must show only that the method used by an expert is scientifically sound and that the expert's opinion is based on sufficient facts to satisfy the reliability requirement of Rule 702. *Id. See also In re Paoli R.R.*

[1] *Daubert* also suggests consideration of the rate of error as well as operating standards if the issue is a specific technique such as spectrographic voice analysis. *Id.* at 594. These factors do not appear applicable to principle component analysis. However, the methods of the PCA implementation are reviewed herein as judged by peer reviewed literature, books on the subject, and corroboration of results.

Yard PCB Litig., 35 F.3d 717, 744-45 (3d Cir. 1994). The Third Circuit in *In re Paoli,* highlighting the "good grounds" requirement of *Daubert* noted that the reliability standard is lower than the merits standard of correctness. *Id.* Further, the Court noted that:

> The grounds for the expert's opinion merely have to be good, they do not have to perfect. The judge might think that there are good grounds for an expert's conclusion even if the judge things that there are better grounds for some alternative conclusion, and even if the judge thinks that a scientist's methodology has some flaws such that if they had been corrected the scientist would have reached a different result.

In re Paoli, at 35 F.3d 744. In the instant case, it is clear that the PCA is based on scientific methods that are both "generally accepted" and based on "good grounds."

Initially, it should be noted that Defendants' motion is long on argument and hyperbole and short on citations to authoritative texts or peer reviewed literature that actually discuss principle component analysis. Similarly, Defendants base their unique analysis on the arguments of their retained experts - Drs. Cowan, Johnson, and Murphy. The State has filed *Daubert* motions challenging the expertise and the analysis of these experts who have apparently been the source of Defendants' criticisms. *See,* Docket Nos. 2072, 2083, & 2074.

Principal component analysis is a well accepted scientific methodology to evaluate sources of contamination. Indeed, both of Defendants' experts who have experience performing environmental source analysis - Dr. Johnson and Dr. Murphy - have themselves used multivariate techniques including PCA to evaluate sources of contamination in the environment *See,* Exhibit B (Murphy depo. 50 and 51) and Exhibit C (Johnson depo. 12, 16, 27, 34, 35, 37, 38, 45). Dr. Olsen identified numerous peer reviewed articles where principal component analysis has been employed in environmental analysis. *See,* p.6-32 & Table 6.11-1 of Olsen's report, Exhibit 2, Defendants motion. In particular, Dr. Olsen has cited and relied on 25 peer reviewed articles where principal component analysis or similar multivariate techniques were

used in similar circumstances (i.e., basin wide watershed water quality studies typically with nonpoint source pollution that include contaminants that are also naturally occurring constituents). *See,* Exhibit A (Olsen Decl. ¶ 9).

Dr. Jim Loftis, Colorado State University professor in the Department of Civil and Environmental Engineering and who also teaches courses on environmental statistics and whose research includes multivariate statistical methods (*See,* Exhibit D (Loftis Decl. ¶¶ 1-4) validates the PCA stating: "Dr. Olsen's approach is based on sound science and well established, accepted statistical and environmental sciences theory and methodology." *See,* Exhibit D (Loftis Decl.¶ 7). Dr. Loftis also agrees that principal component analysis is "...one of the simplest and most commonly applied multivariate statistical methods, [and] has been widely applied in the environmental sciences, including water quality investigations such as the work done by Olsen in the IRW." *See,* Exhibit D (Loftis Decl.¶ 8). And, Dr. Loftis agrees with Dr. Olsen's use of the PCA to identify sources of pollution: "One of the common uses of PCA results in environmental studies is the identification of pollution or geochemical sources." *See,* Exhibit D (Loftis Decl.¶ 9).

Similarly, Dr. Chappel, the environmental statistics expert and teacher who assisted Dr. Olsen with the PCA (*See,* Exhibit E (Chappel Decl.¶ ¶ 1-4) concurs with Professor Loftis and states: "PCA is a type of multivariate statistical analysis commonly applied in environmental science" and that "[i]n many cases the investigators have applied PCA to environments similar to the IRW." *See,* Exhibit E (Chappel Decl.¶ ¶ 7&8). Dr. Chappel concludes that there are many similar cases in the peer reviewed literature were the investigators used principal component analysis as a means of identifying contamination. *See, id.* Consequently, the PCA theory and

methods are not either new or novel as claimed by Defendants. And, Defendants cannot rely on their own experts to support this assertion because they concede its use also.[2]

Finally, Defendants contend that the PCA is litigation based. First, for this criticism to be valid, it is the science underlying the PCA that must be litigation based, not the application of that science to a particular case. The Ninth Circuit has held that where research is litigation based the opinion will be admitted if the expert can point to some objective source, "to show that they have followed the scientific method, as it is practiced by (at least) a recognized minority of scientists in their field." *Daubert v. Merrell Dow Pharm, Inc.*, 43 F.3d 1311, 1319 (9th Cir. 1995). Here, Dr. Olsen has utilized principal component analysis, a well known and commonly used scientific method, and has provided ample authority showing the acceptance of his scientific method and similar applications of that method. As can be seen from the discussion above the science upon which the PCA is based has been well established and applied to similar investigations many times and for many years.

To support their "litigation driven argument" Defendants point to Exhibit 10 to their Motion, a memo written by counsel for the State, as showing that the PCA was directed by counsel and that Dr. Olsen was instructed to use the PCA. As verified by Dr. Olsen's Declaration, the memo was written by the State's counsel to summarize the work *proposed by*

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[2] Defendants also like to argue novelty based on the claim that no other person has been identified as having used PCA with poultry. But this argument fails the logic and facts test. Many articles have been referenced where principle component analysis has been used to identify agricultural pollution sources. *See,* Exhibit A (Olsen Decl.¶ 9). Furthermore, as Professor Loftis points out: "The assertion that no other scientist has seen the poultry signature is extremely misleading, implying that many other scientists have followed this same line of investigation and found nothing. This is simply not true. In fact, many, many scientists have observed poultry impacts in the IRW from whatever perspective they looked or in which they had expertise. While Dr. Olsen may be the first to use principal components analysis in the IRW, his conclusions regarding the significance of poultry waste impacts are not different from the conclusions of other scientists, including those from state and federal agencies, who have studied IRW water quality." *See,* Exhibit D (Loftis Decl.¶ 21).

the experts in this case and was written *after* the experts made a presentation to counsel and earlier recommendations about the work that they do. *See,* Exhibit A (Olsen Decl. ¶ 5). Nowhere in the memo is there an instruction by counsel as to work any expert should perform – as if counsel could give such an instruction.

2. The underlying scientific theory and methodology was reliably applied in the PCA development and application to the IRW.

Defendants' *Daubert* challenge is focused mainly on the method of implementation of the PCA. Again, the underlying scientific theory and methodology were reliably applied in the PCA development and application to the IRW. For example, Professor Loftis documented that the application of the PCA was consistent with principle component analysis undertaken by other investigators in similar circumstances. *See,* Exhibit D (Loftis Decl.¶¶ 9-10, 22). Dr. Chappel is in accord with this opinion. *See,* Exhibit E (Chappel Decl.¶ 8, referencing numerous papers that use the same application as Dr. Olsen and ¶¶ 9&12-13 giving a description of data, methods and protocols applied by Dr. Olsen for the PCA). Dr. Olsen specifically referenced the published papers that used techniques similar to those he used. *See,* Exhibit A (Olsen Decl.¶10).

Defendants' challenges to the PCA application methods appear to be centered on the following complaints: (1) the PCA was not supported by the available data; (2) the results are contrived by Dr. Olsen because he had multiple runs; (3) the means of source identification are flawed; (4 the log conversion error was significant; (5) there is no corroborating fate and transport analysis; and (6) data preparation and treatment was wrong. Each of these concerns can be summarily addressed and dismissed.

a. the PCA *was* supported by the available data

The Defendants' complaint that the PCA was not supported by the available data is based on their retained expert's inability to reproduce the PCA data base used by Dr. Olsen. Dr. Cowan's inability to reproduce the PCA dataset is obviously his own failing. Dr. Chappell explains that he reviewed Dr. Cowan's considered materials and discovered that he did not follow the protocols provided by Dr. Olsen when he used the State's database. *See,* Exhibit E (Chappell Decl.¶ 9, 13 and Attachment A). Moreover, Professor Loftis explains that he was able to reproduce Dr. Olsen results and that the "...PCA results are readily reproducible..." *See,* Exhibit D (Loftis Decl.¶ 14). Thus, this argument of Defendants is refuted by every expert who has reviewed the PCA except Dr. Cowan.

b. The results were *not* contrived by Dr. Olsen because he had multiple runs

Defendants also contend that Dr. Olsen made multiple runs of the PCA because he wanted to keep making runs until he got the answer he wanted. This argument is truly absurd. It ignores the facts and concepts of scientific investigation and validation. First, Dr. Olsen used sensitivity analyses to evaluate if the PCA results would change due to changes in data selection, data treatment, and/or PCA methods. *See,* Exhibit A (Olsen Decl.¶ 15). These sensitivity analyses required multiple PCA runs. All of this is explained in Dr. Olsen's report. *See,* Defendants' motion, Exhibit 2 (Olsen's report pp.6-62 – 6-66 and Tables 6.11-7a and 7b). The Defendants' and their retained experts chose to ignore this information. *See also,* Exhibit D (Loftis Decl.¶ ¶ 19-20) and Exhibit E (Chappell Decl. ¶ 15). Professor Loftis states that due to these sensitivity runs Dr. Olsen: "... has demonstrated that the PCA results are robust..." and that: "Dr. Olsen's expert report is clear that these multiple runs were performed to determine sensitivity of the PCA results to how the data were handled and the PCA was performed." *Id.*

Second, these runs were performed as part of the PCA investigatory analysis. As Dr. Olsen explains "...investigative runs were performed to help in interpretation of the results. For example, the importance of high flow and base flow samples, the difference between dissolved vs. total concentrations, and sources of groundwater and spring contamination were evaluated using different PCA runs. These multiple runs were not "arbitrarily and selectively chosen for presentation" as stated in the Defendants' motion (pg 9) ... they were part of my testing of data selection and treatment and evaluation of different sources. Any good scientist would do the same." *See,* Exhibit A (Olsen Decl.¶ 16). The "multiple run" issue raised by Defendants, in actuality, does not detract from the PCA – it supports it.

c. The means of source identification were *not* flawed

Defendants complain that Dr. Olsen's method of identifying sources with the PCA was flawed. Dr. Olsen used spatial analysis, contamination gradients and the chemical composition of known waste to identify sources with the PCA output. *See,* Exhibit A (Olsen Decl.¶ 10, 21). This method was also used by other investigators using multivariate statistical analysis to identify sources. *Id.* Professor Loftis agrees that Dr. Olsen's source identification method is correct. *See,* Exhibit D (Loftis Decl.¶¶ 22, 24-25). Thus, the methods employed by Dr. Olsen are accepted by investigators using multivariate statistical analysis in the same way employed by Dr. Olsen.

Defendants don't have a basis to critique the technique used by Dr. Olsen for source identification. But, they attempt to make their argument by looking to alleged mistakes in Dr. Olsen's analysis. For example, with respect to the potential cattle source, Defendants and their expert Dr. Johnson assert that Dr. Olsen changed his opinion on the source and, in any event, cattle should have been identified as significant. As explained by Dr. Olsen, "I have not changed my opinion that the compositions of poultry waste and cattle manure are distinct ... [and] [b]oth

Drs. Johnson and Murphy also agreed that the compositions were different … I have continued to state that although cattle manure has a distinct composition, the cattle manure does not contribute a substantial amount of contamination (has "no dominant impact") … The words "distinct" and "dominate" are two different concepts. The Defendants' [have] apparently confused these two words." *See,* Exhibit A (Olsen Decl.¶ 26). This observation is not surprising given the leaching analysis performed by Dr. Olsen (*See. Id*) and as observed by a Professor Loftis: "… cattle in the IRW are fed primarily on grass, which is a natural food source much different from that fed to poultry. Thus cattle manure is much different in composition from poultry waste, with smaller phosphorous content and smaller leachable mass." *See,* Exhibit D (Loftis Decl.¶27).

Dr. Johnson also complains that Dr. Olsen's spatial analysis is flawed and provides several examples. However, Professor Loftis summed up many of these examples as based on Dr. Johnson not understanding where poultry waste was actually applied. Both Drs. Olsen and Fisher point out the same error also demonstrate that additional investigation performed in the IRW revealed that the special analysis is correct. *See,* Exhibit D (Loftis Decl.¶26) and Exhibit A (Olsen Decl.¶ 22-25). Dr Fisher confirms the results of this investigation. *See,* Exhibit H (Fisher Decl.¶¶ 11-13 & 18-20). Thus, using correct and complete data, Dr. Olsen's spatial analysis is correct and it reliably supports the PCA source identification.

d. The log conversion error was *not* significant

The Defendants complain that a log conversion error materially affects the PCA. In actuality, this programming error had no impact on the PCA reliability. It adjusted the scores, but as Dr. Olsen states in this regard: "… the actual results of the principal component analysis (PCA) which consisted of identifying principal components and determining principal loadings and coefficients were not affected by the programming error…" *See*,Exhibit A (Olsen Decl.¶ 28).

Indeed, all of the Defendants' retained experts agreed in their depositions that the patterns on the PCA sore plots remained the same – i.e., there were separate and distinct on these plots. *See,* Exhibit C (Johnson depo. page 194 and exhibit 7); Exhibit B (Murphy depo. page 409 and exhibit 32); and Exhibit G (Cowan depo. page 242 and exhibit 19). Professor Loftis states: "… the most important conclusions from Dr. Olsen's PCA analysis, or any PCA analysis for that matter, are not those revolving around the numerical values of the scores. The important conclusions are rather those concerning the patterns of water quality that are more clearly discerned and displayed by a multivariate analysis than by considering each variable separately." *See,* Exhibit D (Loftis Decl.¶28). *See also,* Exhibit D (Loftis Decl. ¶¶29-30) and Exhibit E (Chappell Decl.¶10).[3] Again, Defendants' complaint is a make weight argument stemming from a programming oversight.

e. There are multiple lines of corroborating fate and transport analysis

Defendants seem to believe that they are correct in claiming that the State has not, even with all of the evaluation and investigation performed by all of its experts, conducted a fate and transport analysis. Consequently, Defendants argue, there is no means by which the PCA results may be judged. However the Defendants are dead wrong on this fate and transport issue. The following is a statement of the fate and transport analysis performed only by Dr. Olsen:

> I considered the mass balances and the amount of poultry waste generated in the IRW. I also evaluated the other sources and masses of contaminants (bacteria and phosphorus). This is the first step in any traditional fate and transport analysis (amount of waste). I then evaluated the amounts of poultry waste applied to fields, the locations of application and the methods of waste disposal (field application or disposal). I also evaluated the amounts of WWTP discharge (phosphorus and metals) and the locations. This is the second step in a traditional fate and transport analysis (how and where the waste was disposed). I then evaluated the chemical and bacterial composition of all major sources of contamination in the IRW based on the above studies and other published studies

[3] This error was corrected by Dr. Olsen's errata. *See,* Exhibit 8 to Defendants' motion.

(poultry waste, cattle manure and WWTP discharges). This is also an evaluation step in a traditional fate and transport analysis (determination of the composition of the wastes). Next I evaluated the nature (chemical and bacterial composition) of the leachate generated from the poultry waste. I did this evaluation by collecting actual samples of runoff from fields on which poultry waste had been applied. I also performed synthetic precipitation leaching tests on poultry waste and cow manure. I then performed calculations of the relative masses of many contaminants that would leach from the poultry waste and cow manure. The collection of runoff samples and performance of leaching tests in the next step in a traditional fate and transport analysis (determining what contaminates actually enter the surface water and groundwater using leaching tests or empirical samples, i.e., field runoff). I then collected samples of the other various environmental components (rivers and streams, Lake Tenkiller, soil, sediments, etc.) of the IRW to determine levels of contamination by comparing the chemical/bacterial composition of these samples to samples collected from unimpacted environmental components (background or reference samples). I designed the collection of samples in a pathway approach so samples were collected in each major environmental component downgradient of waste disposal locations. For waters, samples were collected from the runoff of poultry waste applied fields, then small stream basins, then larger streams/rivers and then Lake Tenkiller). Thus, the transport of chemicals and bacteria was followed from the source to the ultimate fate location. As noted above, I also sampled reference locations to compare the levels of chemical and bacterial found in the IRW. This enable me to conduct a detailed gradient evaluation of major contaminates in the IRW and compare concentration levels to background levels. The collection of samples and gradient evaluation are the next steps in a fate and transport analysis (documentation of the levels of contaminants in the environment and an evaluation of the concentrations changes from source disposal location to deposition location). I then compared the levels and types of contaminants in the wastes (sources) to those in the environmental samples (samples of surface water, sediments, etc) that were collected from the IRW. This is also a traditional step of a fate and transport analysis. This was done directly by evaluating the spatial distribution of individual contaminants (e.g., phosphorus and bacteria) throughout the IRW (surface water, sediments, soils, etc) to see how the contaminants were distributed throughout the IRW.

See, Exhibit A (Olsen Decl.¶ 28). Dr. Olsen then also employed a comparison of other more sophisticated fate and transport analysis performed by him and other State experts:

These included modeling of phosphorus (field runoff/infiltration and stream routing modeling by Dr. Engel; Tenkiller modeling by Dr. Wells); evaluation of phosphorus levels in relationship to poultry house density in small basins (Dr. Engel); geochemical evaluations of sediments in streams and Lake Tenkiller (Dr. Fisher); geochemical (thermodynamic) modeling by me to evaluate and explain chemical changes and geochemical reactions that occur between poultry waste

> leachate and soils; hydrological and geological pathway analysis (Dr. Fisher); and Lake Tenkiller sediment chemical and age dating analysis (Dr. Fisher).

See id. This review led Dr. Olsen to conclude that "...the fate and transport analyses conducted in the IRW were appropriate and sufficient; no additional more complex analyses such as determining partitioning between chemical species and sediments in the IRW rivers were necessary. *Id.* Dr. Fisher also has summarized for the Court his fate and transport analysis in this case. *See*, Exhibit H (Fisher Decl.¶ 16). These analyses led Professor Loftis to conclude: "... Dr. Olsen's conclusions from the PC analysis are also consistent with the other methods of analysis that he relied upon in developing his overall conclusions regarding the impact of poultry waste on IRW water quality. *See*, Exhibit D (Loftis Decl.¶ 26). The state has multiple lines of fate and transport analysis supporting its case and they *all* support the PCA.

f. Data preparation and treatment was proper

Defendants raise a series of concerns (pages 21 to 24 of Defendants' Motion) relating to "substitute and hypothetical data", "averaging multiple values for the same sample", "substitution of inconsistent values for non-detects", "merging incompatible datasets", and "unexplained data substitution and incomplete data sets". These concerns have no basis. Contrary to Defendants' statements, Olsen did not substitute the "mean" for missing data Substituting the mean is not mathematical equivalent to the method used by Dr. Olsen (pairwise deletion) See, Exhibit E (Chappell Decl. ¶ 16) and Exhibit D (Loftis Decl. ¶ 32). (As previously discussed in his sensitivity analysis Dr. Olsen did determine the significance of missing values.)

Also, properly and in accordance with standard practices in environmental analysis, Dr. Olsen averaged the results from split samples appropriately and in the same method as Defendants' experts. See, Exhibit E (Chappell Decl. ¶ 17) and Exhibit D (Loftis Decl. ¶37). Similarly, the use of ½ the detection limit is standard practice and it did not create data and did

not distort the analysis. See, Exhibit E (Chappell Decl. ¶ 18) and Exhibit D (Loftis Decl. ¶¶33-34). And multiple detection limits have no impact on the PCA. *See,* Exhibit D (Loftis Decl. ¶36) Also, the USGS data and CDM data are compatible and can be used together. Dr. Olsen personally worked closely with USGS to make sure the analytical methods were the same as ours and the results could be used together. See, Exhibit E (Chappel Decl. ¶19); Exhibit D (Loftis Decl. ¶38); and Exhibit A (Olsen Decl. ¶29).

Also, as discussed earlier, the complaint regarding unexplained data substitution is based on Dr. Cowan inability to reproduce the data set for the PCA. The incomplete data sets argument is supported by Dr. Cowan's PCA run that includes 419 samples for 56 constituents. (*See*, Defendants' motion p 24). This test is not appropriate and the results are meaningless. PCA is used to explain variance or the variability among samples results for various constituents. Constituents with a large percentage of nondetect values have little variance and are therefore not appropriate for PCA. See, Exhibit E (Chappell Decl. ¶21); Exhibit D (Loftis Decl. ¶35); and Exhibit A (Olsen Decl. ¶29).

Finally, Defendants contend that not all of the data was used so the data must have been hand selected (cherry picked) by Dr. Olsen so he could manipulate the PCA results. (*See*, Defendants' motion p 20). The data used to perform the PCA was collected using a "systematic planning process." Only selected samples were analyzed for a complete list of parameters (chemical/bacterial constituents). These were the samples to be used in the PCA. Other samples were analyzed for a more limited list of parameters and had other intended uses. Thus, the statements in the Defendants' motion (pp 19-20) that the ACCESS database was "mined for data" and that the samples were "hand-selected" is simply not true. See, Exhibit E (Chappell Decl. ¶12) and Exhibit A (Olsen Decl. ¶12).

In sum, none of the data treatment and preparation arguments have merit.

3. The PCA is capable of being tested and has been subject to testing.

Often important to the reliability analysis is the question as to whether the method or technique can be tested. As noted by the *Daubert* Court, scientific method today is based on testing of hypothesis and empirical testing. *Daubert* 509 U.S. at 593. The PCA is not only capable of being tested; it has already been tested. The Defendants do not contend that the PCA was incapable of being tested. Thus, the PCA plainly satisfies one part of the *Daubert* analysis - whether the theory or technique can be (and has been) tested. *Daubert* 509 U.S. at 593.

The PCA was also tested by Defendants' experts Drs. Johnson and Murphy. *See*, Exhibit A (Olsen Decl. ¶14). Also, as mentioned above, the sensitivity analysis also constitutes a test. See, Exhibit E (Chappell Decl. ¶15); Exhibit D (Loftis Decl. ¶19); and Exhibit A (Olsen Decl. ¶15). Clearly, the PCA can be and has been tested.

4. The PCA method has been peer reviewed.

Another aspect or test of reliability listed by the Supreme Court in *Daubert* is peer review and publication of the method. The Supreme Court made clear, however, two important aspects of this test. First, publication is but one type of peer review and second, publication is not the *sin qua non* of admissibility:

> Publication (which is but one element of peer review) is not a *sine qua non* of admissibility; it does not necessarily correlate with reliability, and in some instances well-grounded but innovative theories will not have been published. Some propositions, moreover, are too particular, too new, or of too limited interest to be published. But submission to the scrutiny of the scientific community is a component of "good science," in part because it increases the likelihood that substantive flaws in methodology will be detected. The fact of publication (or lack thereof) in a peer reviewed journal thus will be a relevant, though not dispositive, consideration in assessing the scientific validity of a particular technique or methodology on which an opinion is premised.

Daubert, 509 U.S. at 593-594 (1993) (citations omitted). Thus, the Court acknowledged that there are other forms of peer review than publication in a scientific journal. It also acknowledged that either acceptance or rejection of publication should not be the "litmus test" or *sine qua non* of reliability. Indeed, it would seem that the most reliable method of peer review would be a blind test - either confirming the method or not – by a respected scientist accomplished in the scientific field in question. This is exactly the test that the PCA was subjected to.

Professor Loftis subjected the PCA, specifically, to independent peer review. *See*, Exhibit D (Loftis Decl. ¶5, 14-15, & 17-18). Dr. Loftis reports:

> I have independently examined Dr. Olsen's specific approach and reproduced his calculation of principal component equations and loadings for his data set SW_15, using a different software package from the one that Dr. Olsen used. Through preliminary data analysis, I verified that Dr. Olsen's use of the log transform for this data set is appropriate. Using extensive sensitivity analysis, Dr. Olsen thoroughly tested and effectively demonstrated the robustness of the analyses to the manner in which the data were handled and the PCA was performed. Dr. Olsen has clearly performed his PCA correctly, using currently accepted and published methodology. Therefore, his specific application was correct also.

See, Exhibit D (Loftis Decl. ¶39). This work by Professor Loftis not only satisfies the peer review test, it also shows that the PCA has been tested and it is reliable. Arguably, this method of peer review is preferred to publication.

Finally, the general and specific theories, methods, and applications used in the PCA are validated by the applicable peer reviewed scientific literature. See, Exhibit E (Chappel Decl. ¶¶7-8, &12); Exhibit D (Loftis Decl. ¶¶9-10, 13, 16, 22 &39); and Exhibit A (Olsen Decl. ¶¶ 9-11,). Defendants cite numerous cases to support the claim that the PCA is not based on sound science. Each of the cases cited by Defendants is readily distinguishable from the case at hand. For, example, Defendants cite *Palmer v. Asarco, Inc.* for the proposition that, "without scientific support and research … opinion[s are just] classic *ipse dixit.*" 510 F. Supp. 2d 519, 530-31

(N.D.Okla. 2007). In *Palmer* the expert whose testimony was excluded was presenting a never before adopted theory that tied lead exposure to Attention Deficit Hyperactive Disorder (ADHD). *Id.* There had never been any link between lead exposure and ADHD in any published study and the expert merely examined the plaintiffs, determined they had ADHD and concluded that they had been exposed to lead previously that exposure must have caused the ADHD. Also, a CDC study of 2002 stated unequivocally that there was no compelling evidence that elevated blood lead levels increase risk for ADHD. *Id.* In the instant case Dr. Olsen is not presenting a novel theory, he using an established methodology. And the conclusions reached by that are supported by many other studies and published reports.

5. The cases relied on by Defendants are readily distinguishable.

The Defendants also cite *Ingram v. Solkatronic Chem., Inc.* 2005 WL 3544244 at *3 (N.D. Okla. Dec. 28, 2005), for the proposition that an expert's report must be supported by scientific research. In *Solkatronic* the expert proposed, "a previously unrecognized mechanism by which arsine may produce injury . . . as a result of biotransformation to arsenic". 2005 WL 3544244 at *3. Unlike the expert in *Solkatron,c* Dr. Olsen is not opining as to a unique and unrecognized mechanism. The mechanism by which the poultry waste disposed of and pollutes the waters is none by anyone that has watched runoff following the rain. This idea is not unique.

The Defendants also rely on *B.H. ex rel. Holder v. Gold Fields Mining Corp.*, 2007 WL 188130, at *6 (N.D. Okla. Jan. 22, 2007) for the proposition that an expert should be excluded when his opinion is not supported by testing, data or scientific principles. *Gold Fields* is readily distinguishable from the instant case. In *Gold Fields* the expert whose testimony was excluded did not even utilize a model to form his opinion. *Gold Fields,* at *6 (N.D. Okla. Jan. 22, 2007). Rather, the expert merely testified that he had a conceptual model that could prove causation

which, "exist[ed] only in his mind." *Id.* In the instant case principal component analysis which is well recognized and widely used in a scientific study of this type and is a well accepted scientific theory and methodology to evaluate sources of contamination.

The Defendants cite *Cabrera v. Cordis Corp.*, 134 F.3d 1418, 1420-22 (9th Cir. 1998) for the proposition that the court determine whether an expert formed his opinions solely for litigation. In *Cabrera* at issue was whether the silicone components of a shunt caused a growth injuring the plaintiff. *Id.* The expert whose testimony was excluded was only tasked with examining the growth and purposely ignored the cause of the injury, as such; his testimony was excluded for lack of relevance. Here, Dr. Olsen's testimony is relevant.

The Defendants also cite *Sorenson v. Shaklee Corp.*, 31 F.3d 638, 649 (8th Cir. 1994), for the proposition that scientific method must be followed and not "turned on its head." The expert in *Sorenson* satisfied none of the applicable *Daubert* elements. *Id.* at 649. As shown above, here, the PCA meets all the *Daubert* criteria.

The Defendants also cite *Allgood v. GM Corp.*, 2006 WL 2669337 at * 7. The expert in *Allgood* did not follow applicable EPA guidance and "cherry picked" his data. *Id.* at *9. Unlike the expert in *Allgood* Dr. Olsen was objective in his data selection and followed established peer reviewed methods. Thus, none of the Defendants' cases are persuasive.

III. Conclusion

All of the *Daubert* factors weigh in support of reliability of the PCA. Indeed, much work has occurred since the preliminary injunction hearing. Additional research and analysis has confirmed the reliability of the PCA. It is clear that the PCA is supported by reliable scientific

methods and application. Thus, the PCA is not litigation driven and were not developed by counsel. Accordingly, Defendants' Motion should be denied in all respects.

Respectfully Submitted,

W.A. Drew Edmondson OBA # 2628
ATTORNEY GENERAL
Kelly H. Burch OBA #17067
J. Trevor Hammons OBA #20234
Daniel P. Lennington OBA #21577
ASSISTANT ATTORNEYS GENERAL
State of Oklahoma
313 N.E. 21st St.
Oklahoma City, OK 73105
(405) 521-3921

/s/ David P. Page
M. David Riggs OBA #7583
Joseph P. Lennart OBA #5371
Richard T. Garren OBA #3253
Sharon K. Weaver OBA #19010
Robert A. Nance OBA #6581
D. Sharon Gentry OBA #15641
David P. Page OBA #6852
RIGGS, ABNEY, NEAL, TURPEN,
ORBISON & LEWIS
502 West Sixth Street
Tulsa, OK 74119
(918) 587-3161

Louis W. Bullock OBA #1305
Robert M. Blakemore OBA 18656
BULLOCK, BULLOCK & BLAKEMORE
110 West Seventh Street Suite 707
Tulsa OK 74119
(918) 584-2001

Frederick C. Baker
(admitted *pro hac vice*)
Lee M. Heath
(admitted *pro hac vice)*
Elizabeth C. Ward
(admitted *pro hac vice*)
Elizabeth Claire Xidis
(admitted *pro hac vice*)

MOTLEY RICE, LLC
28 Bridgeside Boulevard
Mount Pleasant, SC 29465
(843) 216-9280

William H. Narwold
(admitted *pro hac vice*)
Ingrid L. Moll
(admitted *pro hac vice)*
MOTLEY RICE, LLC
20 Church Street, 17th Floor
Hartford, CT 06103
(860) 882-1676

Jonathan D. Orent
(admitted *pro hac vice)*
Michael G. Rousseau
(admitted *pro hac vice)*
Fidelma L. Fitzpatrick
(admitted *pro hac vice)*
MOTLEY RICE, LLC
321 South Main Street
Providence, RI 02940
(401) 457-7700

Attorneys for the State of Oklahoma

CERTIFICATE OF SERVICE

I hereby certify that on this 5th day of June, 2009, I electronically transmitted the above and foregoing pleading to the Clerk of the Court using the ECF System for filing and a transmittal of a Notice of Electronic Filing to the following ECF registrants:

W. A. Drew Edmondson, Attorney General	fc_docket@oag.state.ok.us
Kelly H. Burch, Assistant Attorney General	kelly_burch@oag.state.ok.us
M. David Riggs	driggs@riggsabney.com
Joseph P. Lennart	jlennart@riggsabney.com
Richard T. Garren	rgarren@riggsabney.com
Sharon K. Weaver	sweaver@riggsabney.com
Robert A. Nance	rnance@riggsabney.com
D. Sharon Gentry	sgentry@riggsabney.com
David P. Page	dpage@riggsabney.com

RIGGS, ABNEY, NEAL, TURPEN, ORBISON & LEWIS

Louis Werner Bullock lbullock@bullock-blakemore.com
Robert M. Blakemore bblakemore@bullock-blakemore.com
BULLOCK, BULLOCK & BLAKEMORE

Frederick C. Baker fbaker@motleyrice.com
Elizabeth C. Ward lward@motleyrice.com
Elizabeth Claire Xidis cxidis@motleyrice.com
William H. Narwold bnarwold@motleyrice.com
Ingrid L. Moll imoll@motleyrice.com
Jonathan D. Orent jorent@motleyrice.com
Michael G. Rousseau mrousseau@motleyrice.com
Fidelma L. Fitzpatrick ffitzpatrick@motleyrice.com
MOTLEY RICE, LLC
Counsel for State of Oklahoma

Robert P. Redemann rredemann@pmrlaw.net
PERRINE, MCGIVERN, REDEMANN, REID, BARRY & TAYLOR, P.L.L.C.

David C. Senger david@cgmlawok.com

Robert E Sanders rsanders@youngwilliams.com
Edwin Stephen Williams steve.williams@youngwilliams.com
YOUNG WILLIAMS P.A.
Counsel for Cal-Maine Farms, Inc and Cal-Maine Foods, Inc.

John H. Tucker jtucker@rhodesokla.com
Theresa Noble Hill thill@rhodesokla.com
Colin Hampton Tucker ctucker@rhodesokla.com
Kerry R. Lewis klewis@rhodesokla.com
RHODES, HIERONYMUS, JONES, TUCKER & GABLE

Terry Wayen West terry@thewestlawfirm.com
THE WEST LAW FIRM

Delmar R. Ehrich dehrich@faegre.com
Bruce Jones bjones@faegre.com
Krisann C. Kleibacker Lee kklee@faegre.com
Todd P. Walker twalker@faegre.com
Christopher H. Dolan cdolan@faegre.com
Melissa C. Collins mcollins@faegre.com
Colin C. Deihl cdeihl@faegre.com
Randall E. Kahnke rkahnke@faegre.com
FAEGRE & BENSON, LLP

Dara D. Mann dmann@mckennalong.com
MCKENNA, LONG & ALDRIDGE LLP
Counsel for Cargill, Inc. & Cargill Turkey Production, LLC

James Martin Graves jgraves@bassettlawfirm.com
Gary V Weeks gweeks@bassettlawfirm.com
Woody Bassett wbassett@bassettlawfirm.com
K. C. Dupps Tucker kctucker@bassettlawfirm.com
Earl Lee "Buddy" Chadick bchadick@bassettlawfirm.com
BASSETT LAW FIRM

George W. Owens gwo@owenslawfirmpc.com
Randall E. Rose rer@owenslawfirmpc.com
OWENS LAW FIRM, P.C.
Counsel for George's Inc. & George's Farms, Inc.

A. Scott McDaniel smcdaniel@mhla-law.com
Nicole Longwell nlongwell@mhla-law.com
Philip Hixon phixon@mhla-law.com
Craig A. Merkes cmerkes@mhla-law.com
MCDANIEL, HIXON, LONGWELL & ACORD, PLLC

Sherry P. Bartley sbartley@mwsgw.com
MITCHELL, WILLIAMS, SELIG, GATES & WOODYARD, PLLC
Counsel for Peterson Farms, Inc.

John Elrod jelrod@cwlaw.com
Vicki Bronson vbronson@cwlaw.com
P. Joshua Wisley jwisley@cwlaw.com
Bruce W. Freeman bfreeman@cwlaw.com
D. Richard Funk rfunk@cwlaw.com
CONNER & WINTERS, LLP
Counsel for Simmons Foods, Inc.

Stephen L. Jantzen sjantzen@ryanwhaley.com
Paula M. Buchwald pbuchwald@ryanwhaley.com
Patrick M. Ryan pryan@ryanwhaley.com
RYAN, WHALEY, COLDIRON & SHANDY, P.C.

Mark D. Hopson mhopson@sidley.com
Jay Thomas Jorgensen jjorgensen@sidley.com

Timothy K. Webster twebster@sidley.com
Thomas C. Green tcgreen@sidley.com
Gordon D. Todd gtodd@sidley.com
SIDLEY, AUSTIN, BROWN & WOOD LLP

Robert W. George robert.george@tyson.com
L. Bryan Burns bryan.burns@tyson.com
Timothy T. Jones tim.jones@tyson.com
TYSON FOODS, INC

Michael R. Bond michael.bond@kutakrock.com
Erin W. Thompson erin.thompson@kutakrock.com
Dustin R. Darst dustin.darst@kutakrock.com
KUTAK ROCK, LLP
Counsel for Tyson Foods, Inc., Tyson Poultry, Inc., Tyson Chicken, Inc., & Cobb-Vantress, Inc.

R. Thomas Lay rtl@kiralaw.com
KERR, IRVINE, RHODES & ABLES

Frank M. Evans, III fevans@lathropgage.com
Jennifer Stockton Griffin jgriffin@lathropgage.com
David Gregory Brown
LATHROP & GAGE LC
Counsel for Willow Brook Foods, Inc.

Robin S Conrad rconrad@uschamber.com
NATIONAL CHAMBER LITIGATION CENTER

Gary S Chilton gchilton@hcdattorneys.com
HOLLADAY, CHILTON AND DEGIUSTI, PLLC
Counsel for US Chamber of Commerce and American Tort Reform Association

D. Kenyon Williams, Jr. kwilliams@hallestill.com
Michael D. Graves mgraves@hallestill.com
HALL, ESTILL, HARDWICK, GABLE, GOLDEN & NELSON
Counsel for Poultry Growers/Interested Parties/ Poultry Partners, Inc.

Richard Ford richard.ford@crowedunlevy.com
LeAnne Burnett leanne.burnett@crowedunlevy.com
CROWE & DUNLEVY
Counsel for Oklahoma Farm Bureau, Inc.

Kendra Akin Jones, Assistant Attorney General — Kendra.Jones@arkansasag.gov
Charles L. Moulton, Sr Assistant Attorney General — Charles.Moulton@arkansasag.gov
Counsel for State of Arkansas and Arkansas National Resources Commission

Mark Richard Mullins — richard.mullins@mcafeetaft.com
MCAFEE & TAFT
Counsel for Texas Farm Bureau; Texas Cattle Feeders Association; Texas Pork Producers Association and Texas Association of Dairymen

Mia Vahlberg — mvahlberg@gablelaw.com
GABLE GOTWALS

James T. Banks — jtbanks@hhlaw.com
Adam J. Siegel — ajsiegel@hhlaw.com
HOGAN & HARTSON, LLP
Counsel for National Chicken Council; U.S. Poultry and Egg Association & National Turkey Federation

John D. Russell — jrussell@fellerssnider.com
FELLERS, SNIDER, BLANKENSHIP, BAILEY & TIPPENS, PC

William A. Waddell, Jr. — waddell@fec.net
David E. Choate — dchoate@fec.net
FRIDAY, ELDREDGE & CLARK, LLP
Counsel for Arkansas Farm Bureau Federation

Barry Greg Reynolds — reynolds@titushillis.com
Jessica E. Rainey — jrainey@titushillis.com
TITUS, HILLIS, REYNOLDS, LOVE, DICKMAN & MCCALMON

Nikaa Baugh Jordan — njordan@lightfootlaw.com
William S. Cox, III — wcox@lightfootlaw.com
LIGHTFOOT, FRANKLIN & WHITE, LLC
Counsel for American Farm Bureau and National Cattlemen's Beef Association

Duane L. Berlin — dberlin@levberlin.com
LEV & BERLIN PC
Counsel for Council of American Survey Research Organizations & American Association for Public Opinion Research

Also on this 26th day of May, 2009 I mailed a copy of the above and foregoing pleading to:

Thomas C Green -- via email: tcgreen@sidley.com
Sidley, Austin, Brown & Wood LLP

Dustin McDaniel
Justin Allen
Office of the Attorney General (Little Rock)
323 Center St, Ste 200
Little Rock, AR 72201-2610

Steven B. Randall
58185 County Rd 658
Kansas, Ok 74347

Cary Silverman -- via email: csilverman@shb.com
Victor E Schwartz
Shook Hardy & Bacon LLP (Washington DC)

/s/ David P. Page
David P. Page